

## Chapter 7

### Evaluating the Tier IV Baseline Ecological Risk Assessment

#### 7.1 Introduction

Tier IV is reserved for the largest and most complex sites requiring multiple-year sampling or modeling programs and is only appropriate where data and an ERA with the highest degree of certainty are required for the FS/RD-RA. Complex sites are those with complex chemical interactions among numerous COECs and exposure matrices, widespread contamination or numerous contamination sources, and sites requiring the examination of potential risk reduction over time (e.g., Rocky Mountain Arsenal [EPA 1993f]). This tier includes biological studies of longer duration and greater expense (e.g., multi-year population and community level studies) or complex exposure modeling.

Tier IV investigations are expected to be warranted at very few sites. The Tier IV effort may require additional abiotic sampling and/or tissue residue sampling to establish correlation of cause-effect and/or verification of a model.<sup>1</sup> To execute these models, a detailed understanding of the life history and population dynamics of species studied is required. Complex, mathematical ecosystem models which describe the mechanisms of action to address exposure processes and pathways and toxic effects are applied in this tier. Methods for linking laboratory-derived toxicity data to fish population models may be applied (Barnhouse, Suter, and Rosen 1990). Other models which address ecosystem functions (energy and nutrient cycling) may be developed.

#### 7.2 Problem Formulation

Following completion of the Tier III ERA, adequacy of the results to support the FS/RD-RA should be examined again. Although unlikely, if it is determined that expanded biological investigations or complex modeling are needed to support multiple remediation decisions, then problem formulation for Tier IV should proceed. Similar to the problem formulation stages of Tiers II and III,

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<sup>1</sup> All these models are likely to require high costs and biological monitoring/field validation efforts involving multiyear and multiseasonal studies. These population and community models are often data intensive.

previously collected data should be reviewed for adequacy and any data gaps identified.

Once the data needs are identified, Tier IV problem formulation should proceed. Biological community sampling methods employed in Tier IV may be more extensive than those used in Tier II and Tier III, but they are more apt to be the same as those used in Tier III. The sampling methods chosen for use in Tier IV would be used over a period of several years: however, timing of the sampling (e.g., monthly, seasonally) should be the same as in Tier III. Locations of biological sampling should be the same as those in Tier III. Because of the elapsed time between Tiers III and IV, additional chemical samples may be needed to support any biological studies and modeling conducted in Tier IV.

Following are brief descriptions of the biological studies and modeling appropriate within Tier IV:

##### 7.2.1 Field Studies

- Quantitative biota (population/community) sampling extending over multiple seasons and years to document long-term variability or trends of potentially exposed biota.
- Quantitative biota sampling in reference areas during selected seasons to provide sufficient data for statistical comparisons to the data collected at exposure points.
- Additional surveys of Federal- or state-protected species suspected of being exposed to COECs.
- If needed, collection of exposure point media for additional chemical analysis to support the biological sampling and modeling results.
- If needed, collection of abiotic media samples from reference areas.

##### 7.2.2 Ecosystem Modeling Studies

- Complex, mathematical ecosystem models addressing such attributes as energy flow, material cycling, and food web assembly (Hull and Suter 1993).

### 7.2.3 Laboratory Analysis

- Laboratory analysis of biological samples (e.g., periphyton, benthic invertebrates, plants), as needed for taxonomy.
- If needed chemical analysis of exposure point media for the COECs or specific species of COECs.
- If needed, chemical analysis of reference area physical media for the COECs.

### 7.3 Data Collection and Analysis

Data from field and laboratory studies and modeling should be generated in accordance with the Tier IV work plan and USACE (1995b) Technical Project Planning document. As discussed above, the work plan should provide, at a minimum, a description of objectives appropriate for Tier IV details of the field and laboratory methods, including analytical quantitation; full descriptions of the models to be used, including

applicability of the model, assumptions, input data requirements, database compatibility, input/output formats, and output description; data quality review methodology; and field and modeling data presentation and integration with previously collected data.

### 7.4 Revision of the Tier III ERA

Following the collection and compilation of biological and modeling data from the Tier IV analyses, the Tier III ERA should be revised to incorporate the additional information collected. Overall, the additional information provided through Tier IV investigations should further reduce the level of uncertainty associated with the ERA. It is recommended that if multiyear biological sampling is included in Tier IV, the resulting data should be compiled, reviewed, and the ERA revised on an annual basis. By conducting annual data reviews and ERA updates, it may be determined that the Tier IV data collected to date are sufficient to provide risk-based answers to the remediation alternative questions, and further sampling is not necessary.